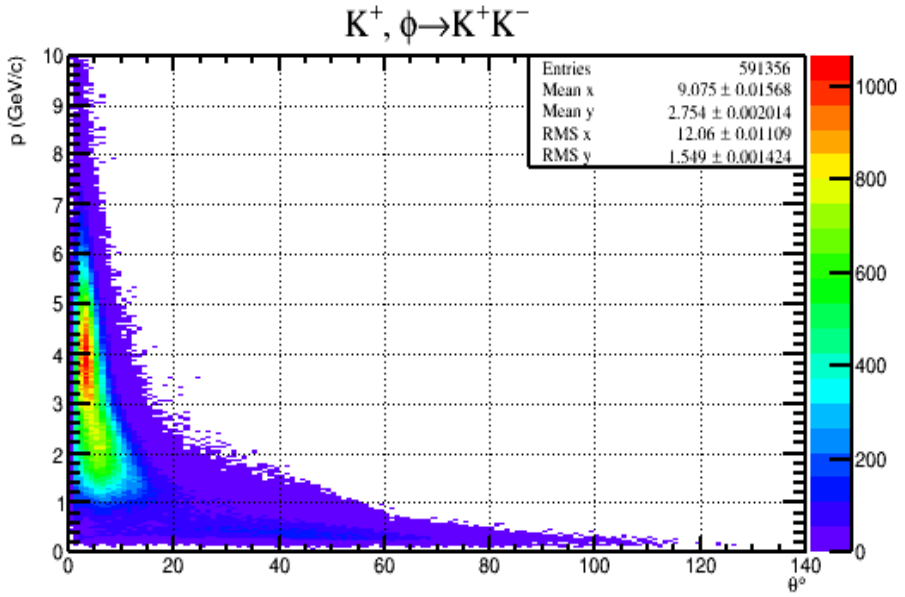
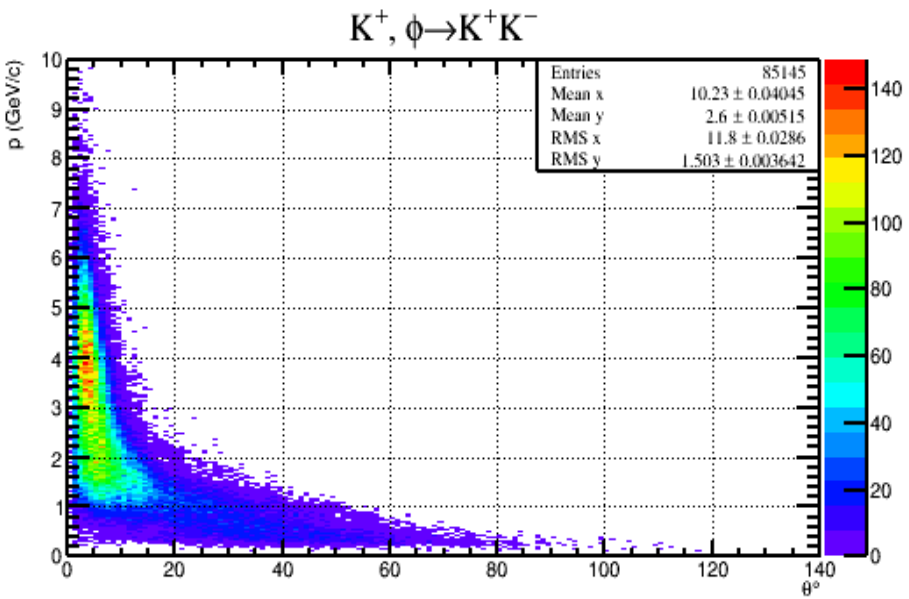
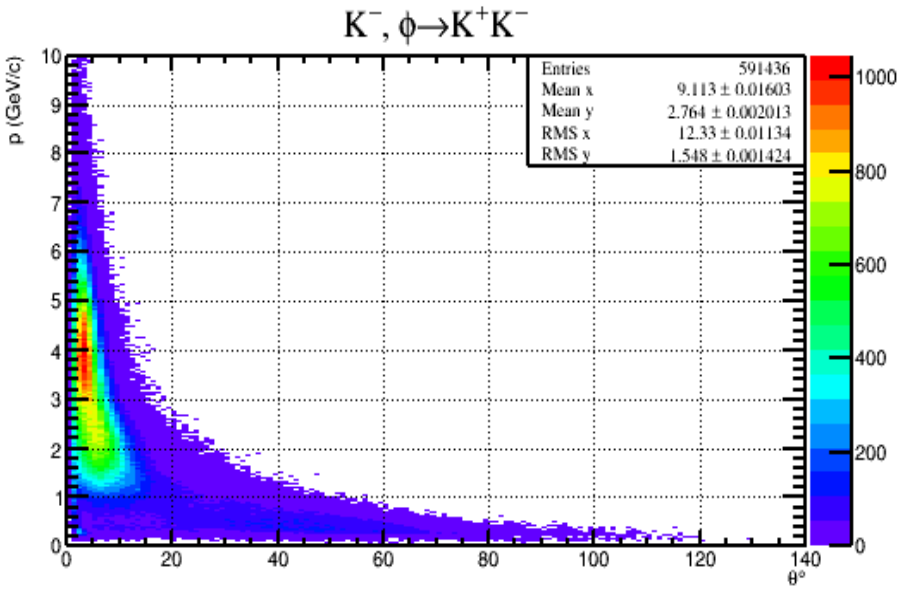
Phi Meson Physics Analysis

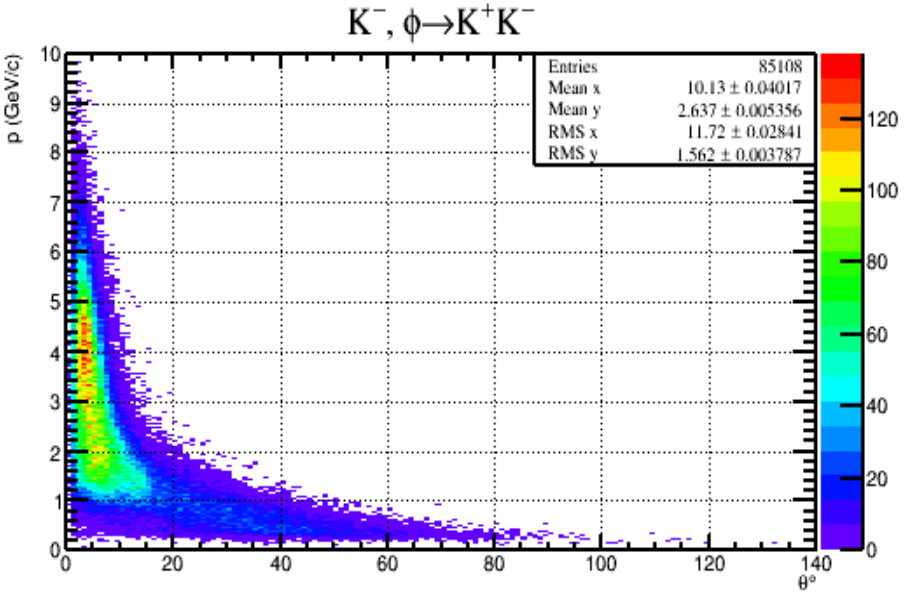
- ~~TOF PID of Kaons at GlueX~~
- Purpose: Investigate the properties of the Phi meson and analyze:
    - Kaon distributions in Lab Frame
    - Kaon distributions in HE Frame
    - Beam asymmetry
    - Spin Density Matrix elements (Future)

K+/K- P vs Theta Distributions in Lab Frame; MC(left) Data(right)

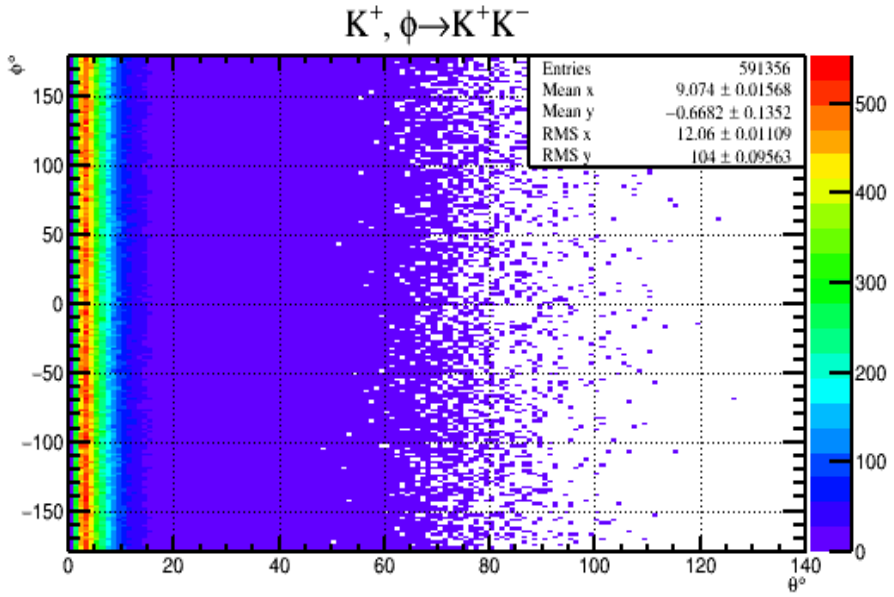


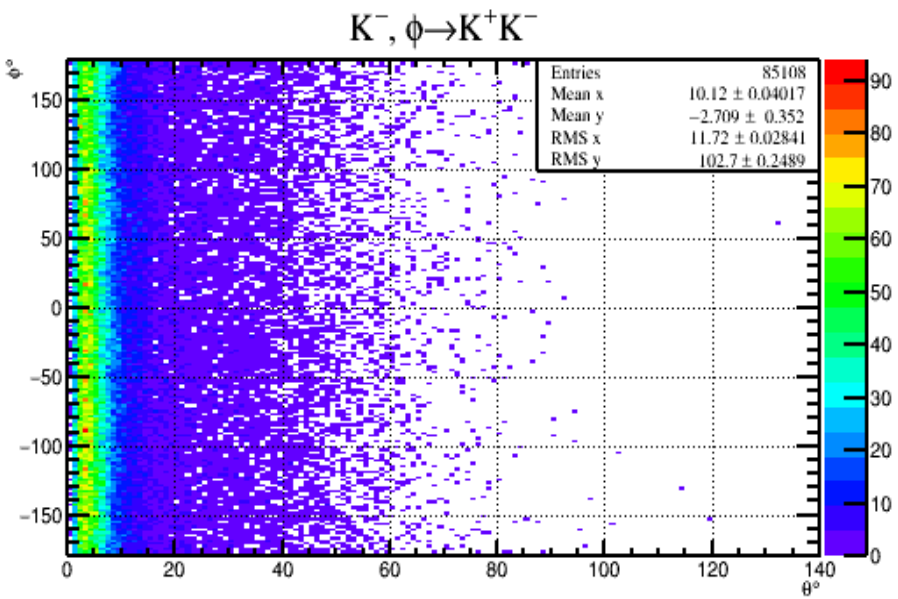


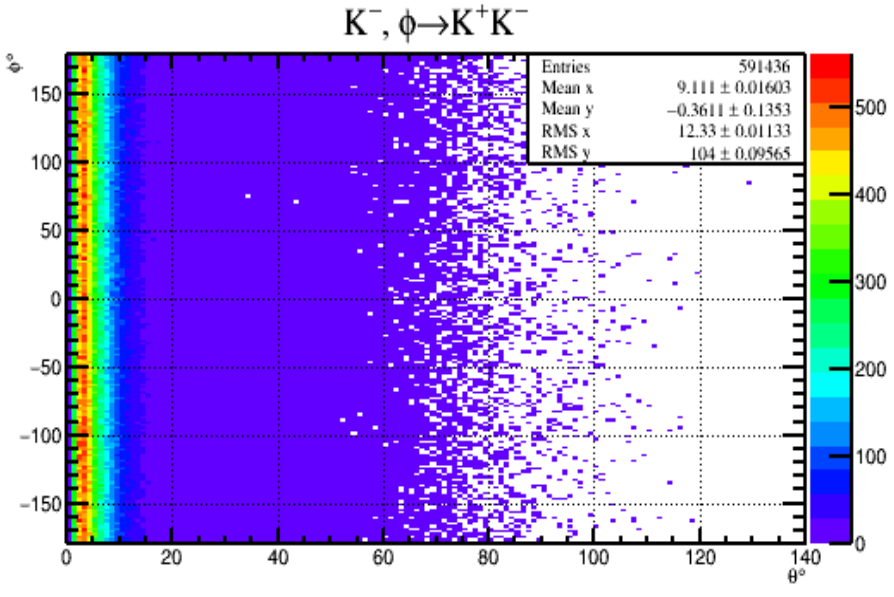


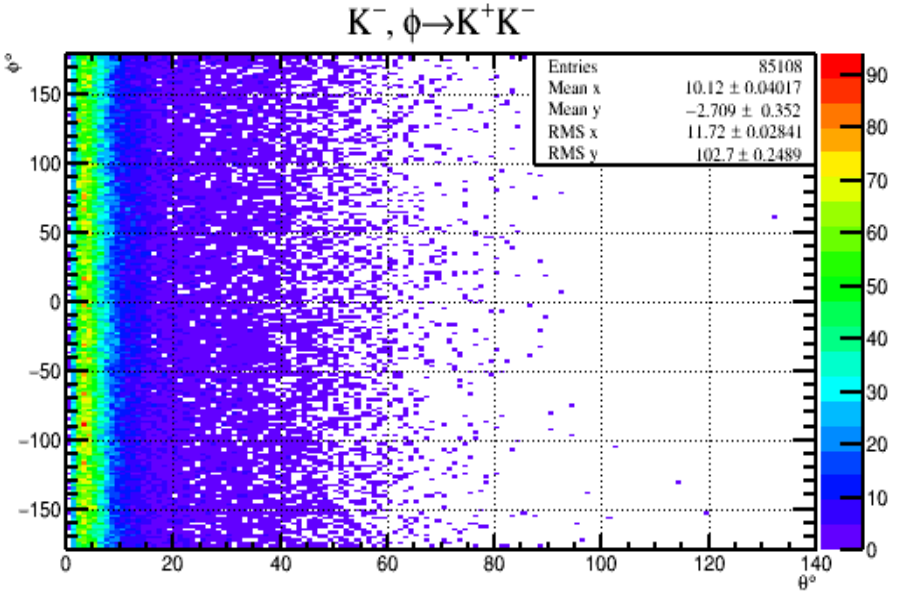


K+/K- Phi vs Theta Distributions in Lab Frame; MC(left) Data(right)



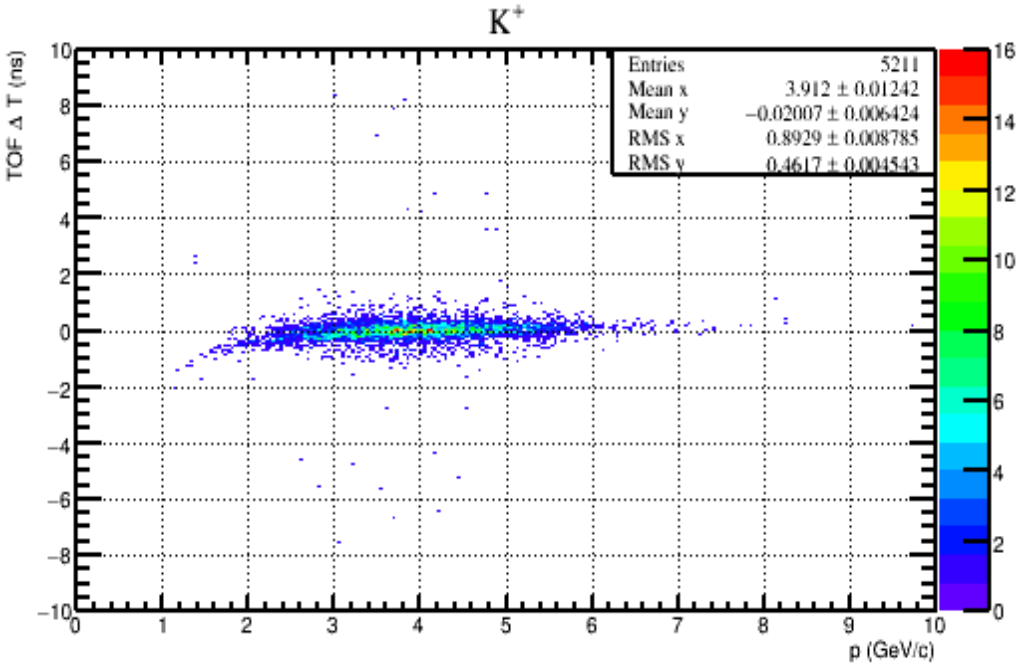


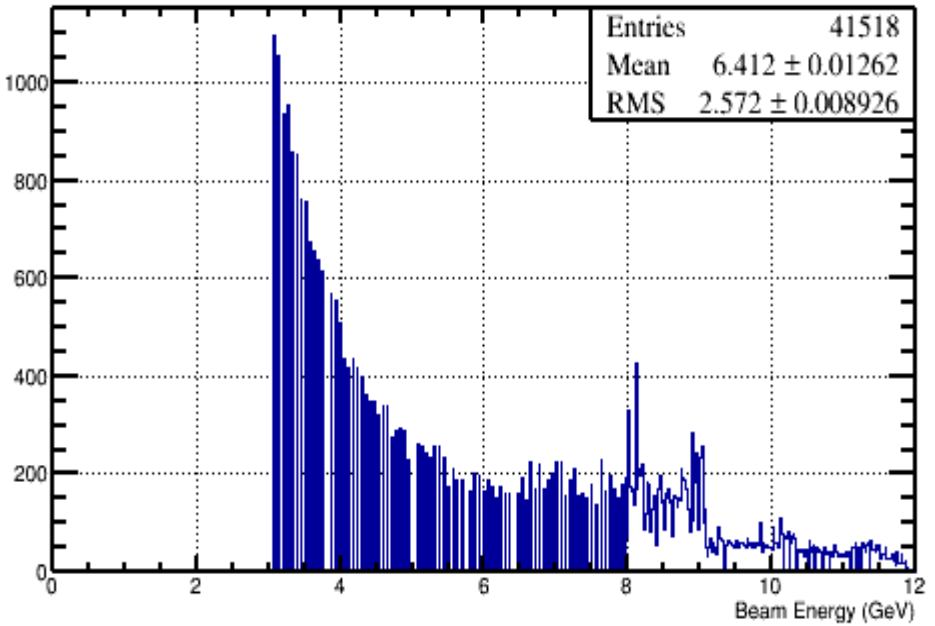




Beam Asymmetry / Spin Density Matrix Elements

- In order to study beam asymmetry or the spin density matrix elements of the phi, certain cuts on the data must be done:
    - Cut on Beam Energy ~ [8.5-9.0] GeV
        - Enforces beam polarization
    - Cut on Phi Mass ~[0.95 – 1.1] GeV/c^2
        - Enforces the polarization is transferred to Phi and not BG
    - 2 Issues Right Now:
        - Beam does not show a good coherent peak
        - Kaon ID study useless with high energy beam energy cut

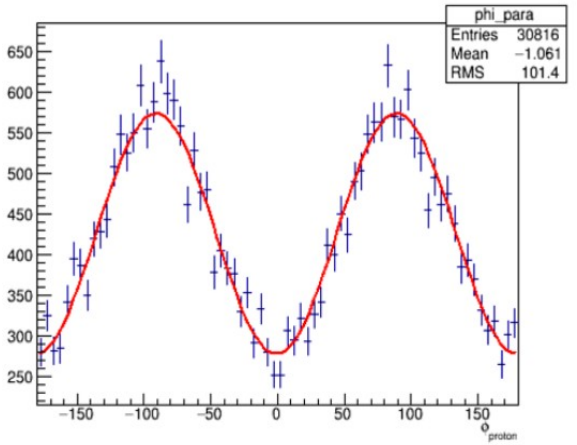




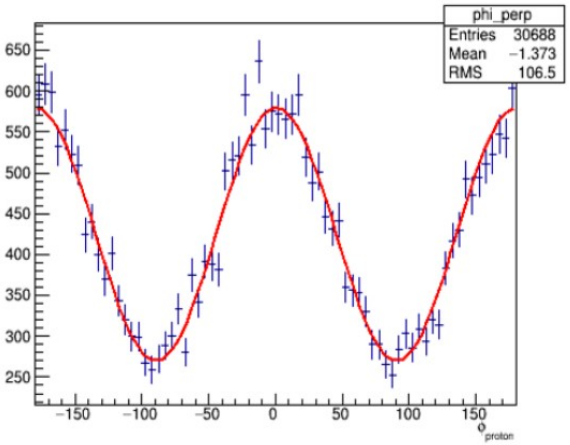
Beam Asymmetry Study

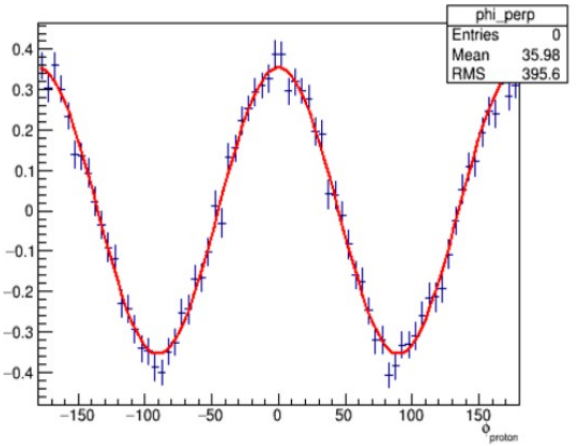
- Ignoring the previous issues, lets simply see what we get.
- Procedure: Show 3 different steps of data
  - Data with no cuts
  - Data with a beam cut
  - Data with beam and phi mass cut
  - Compare to Justin Stevens' work from Analysis Workshop

$d\sigma_{\parallel} \sim 1 - P_{\parallel}\Sigma cos2\phi$

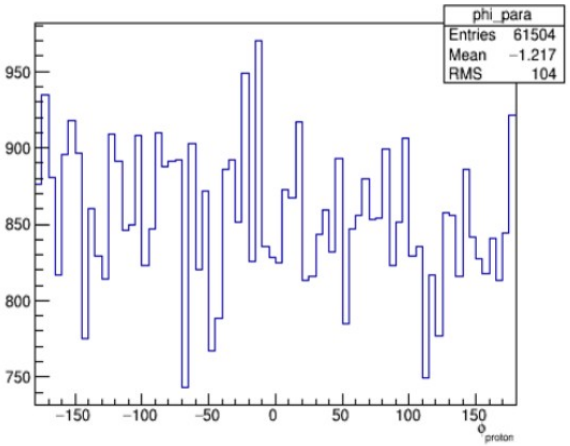


$d\sigma_{\perp} \sim 1 + P_{\perp}\Sigma cos2\phi$





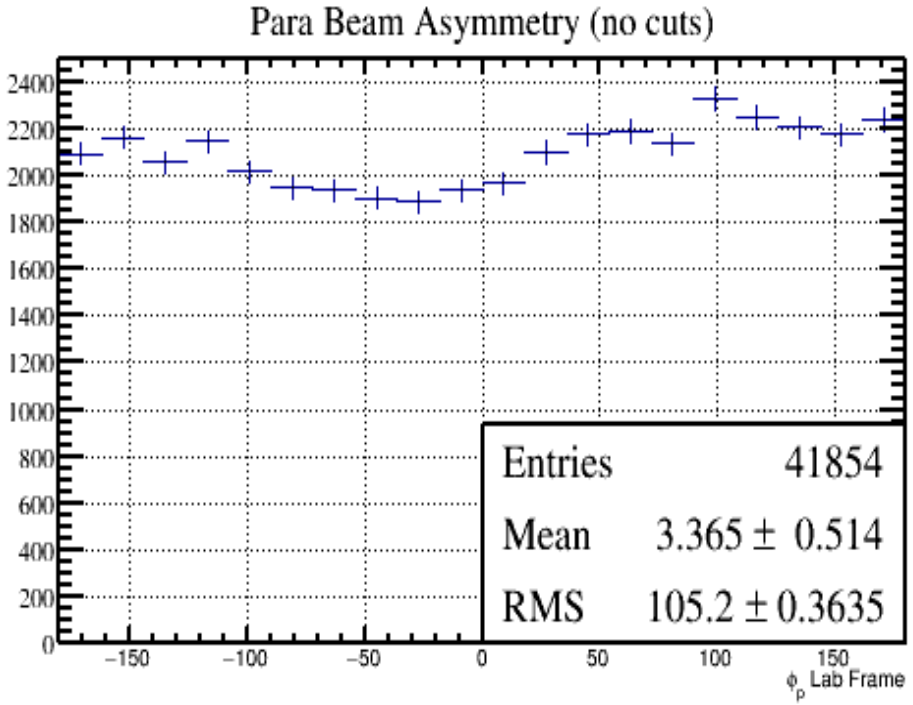
Try: $\frac{Y_{\perp} - Y_{\parallel}}{Y_{\perp} + Y_{\parallel}} = P\Sigma cos(2\phi)$

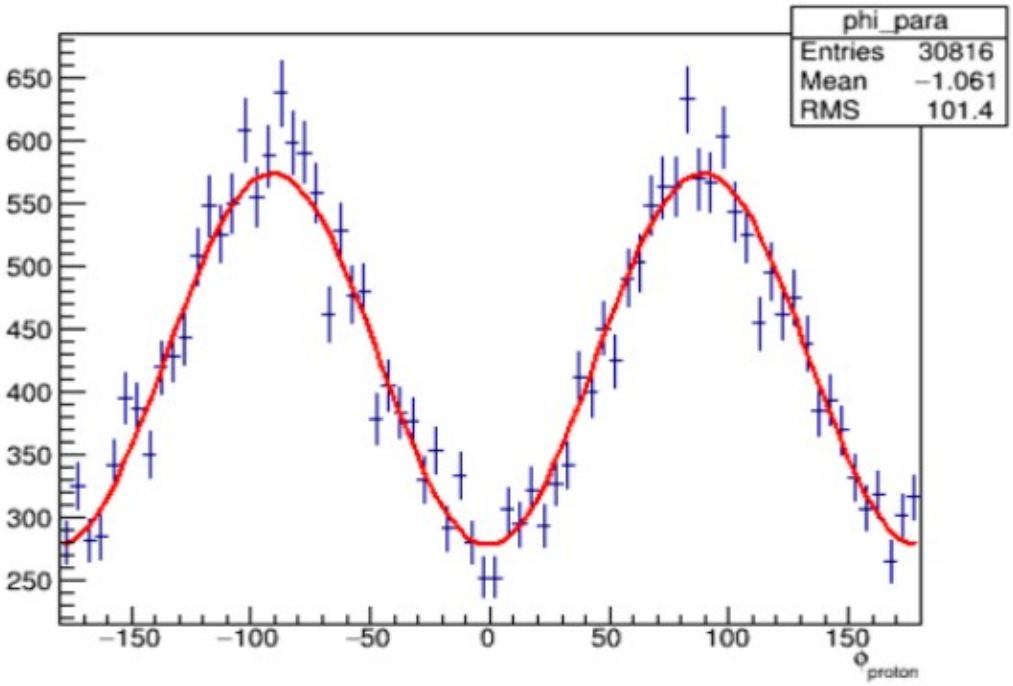


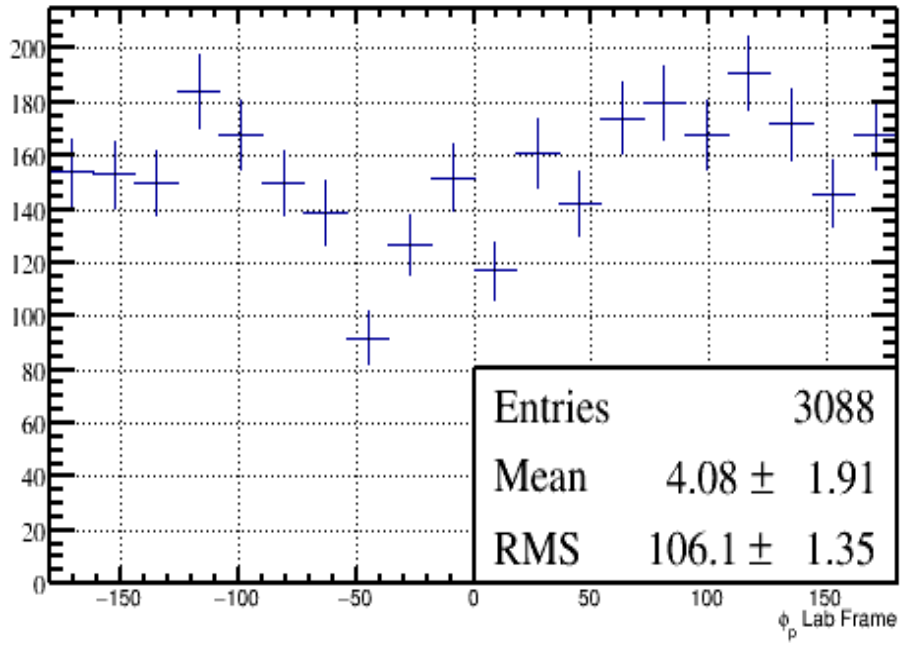
$Y_{\perp} + Y_{\parallel}$

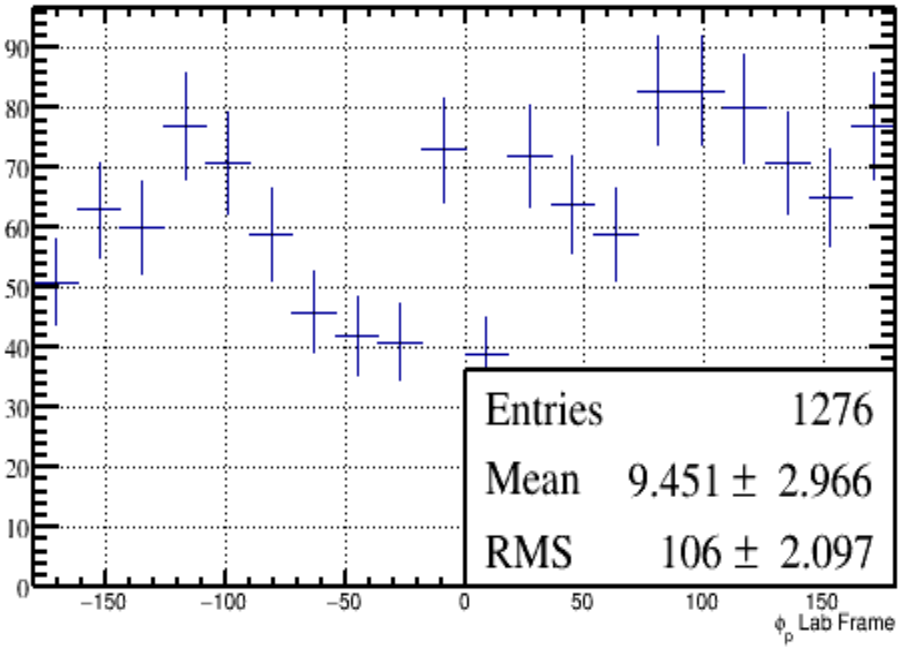
Para Beam Results

$$d\sigma_{||} \sim 1 - P_{||}\Sigma cos2\phi$$



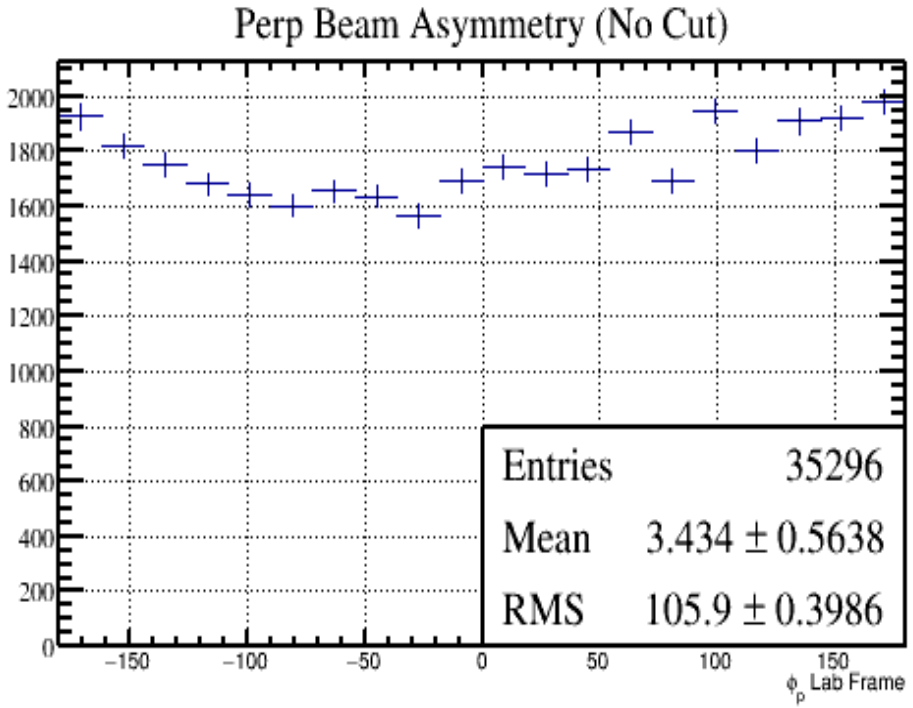


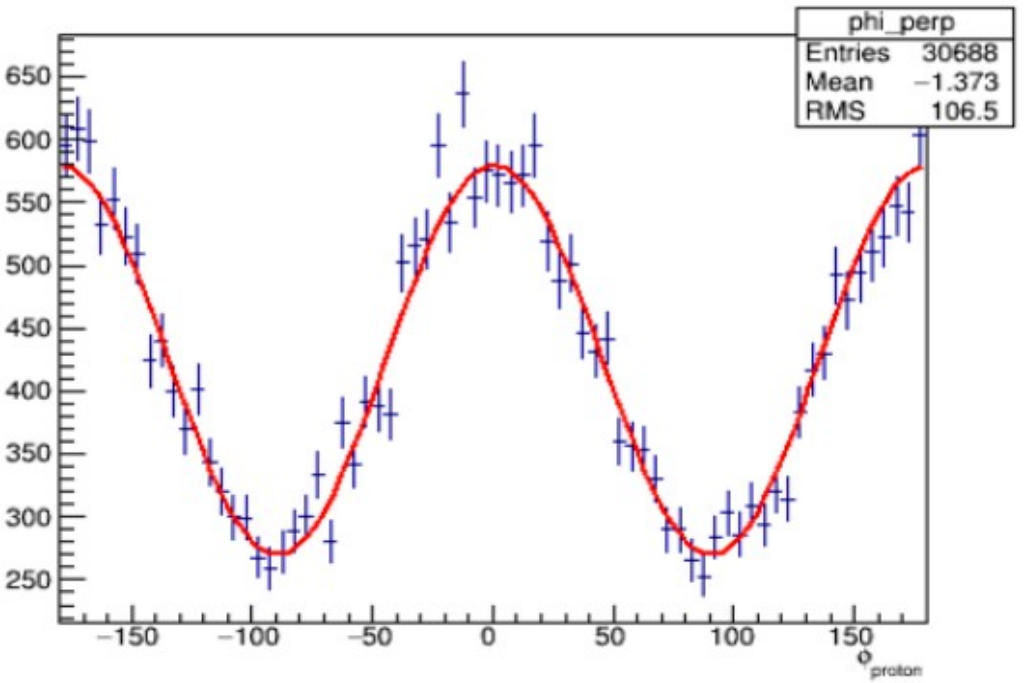


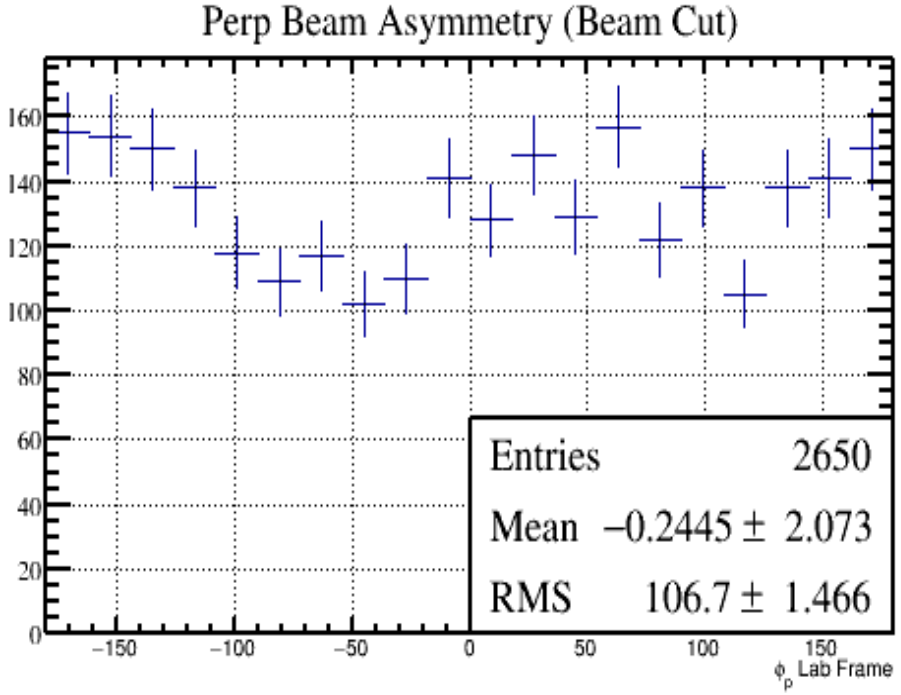


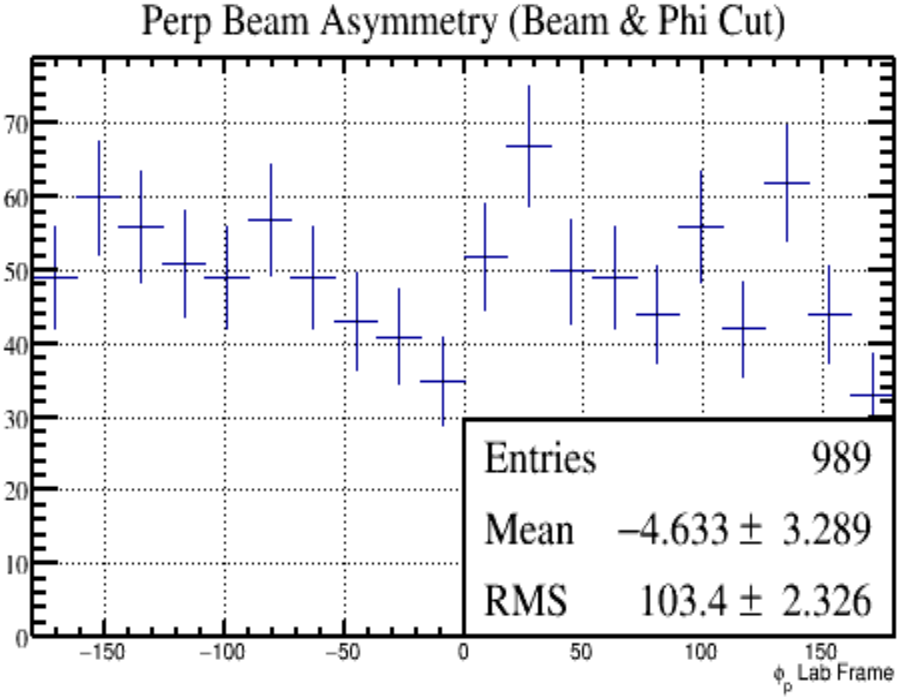
Perp Beam Results

$$d\sigma_{\perp} \sim 1 + P_{\perp}\Sigma cos2\phi$$

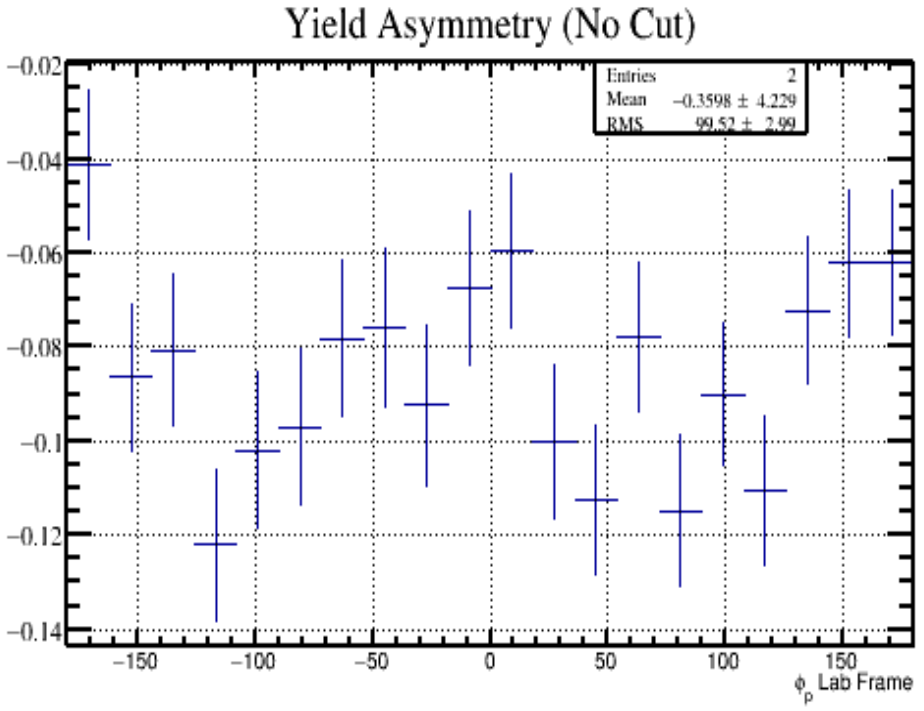


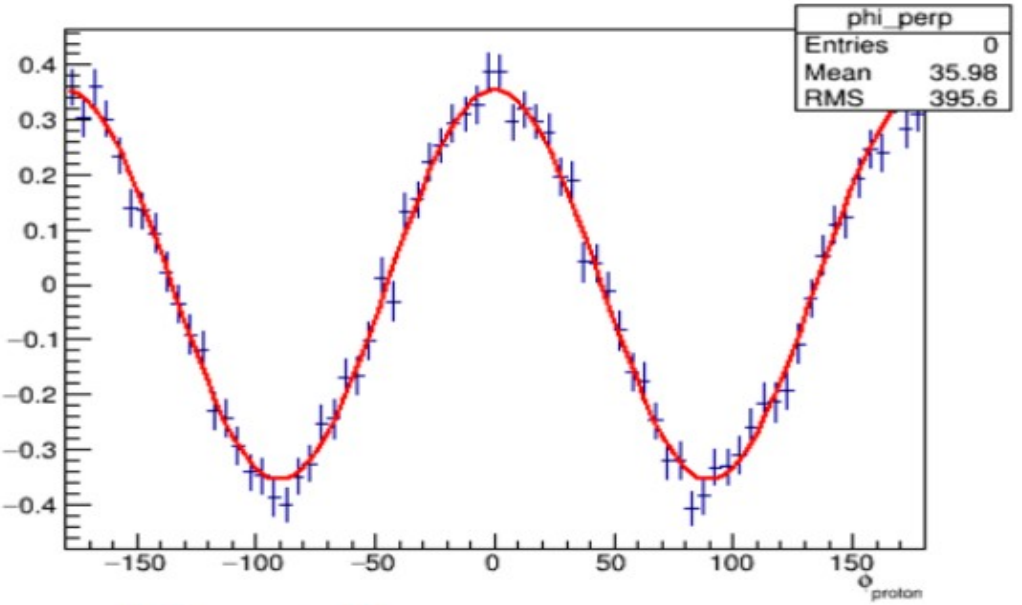




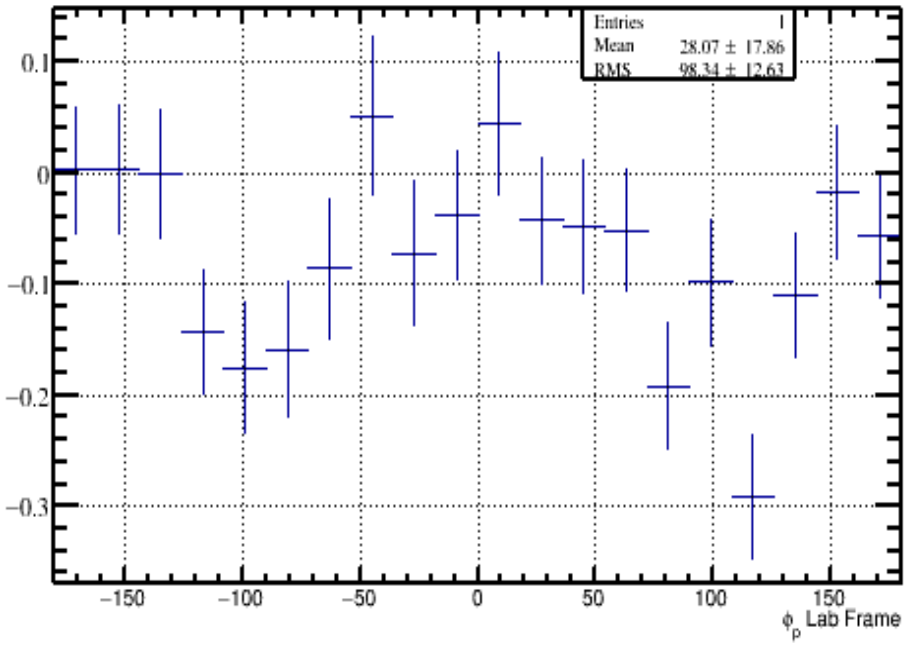


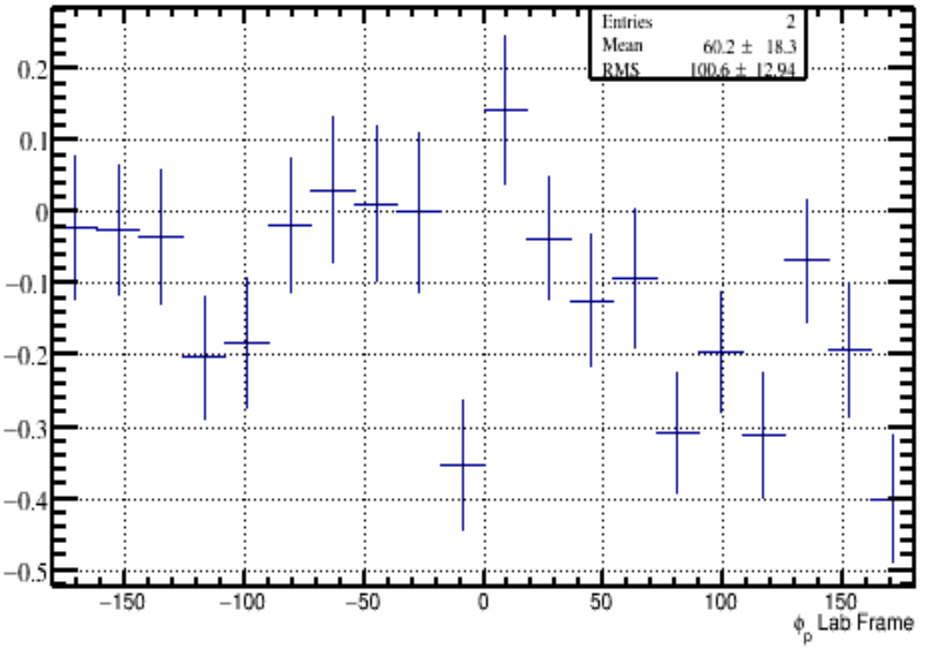
Yield Beam Results



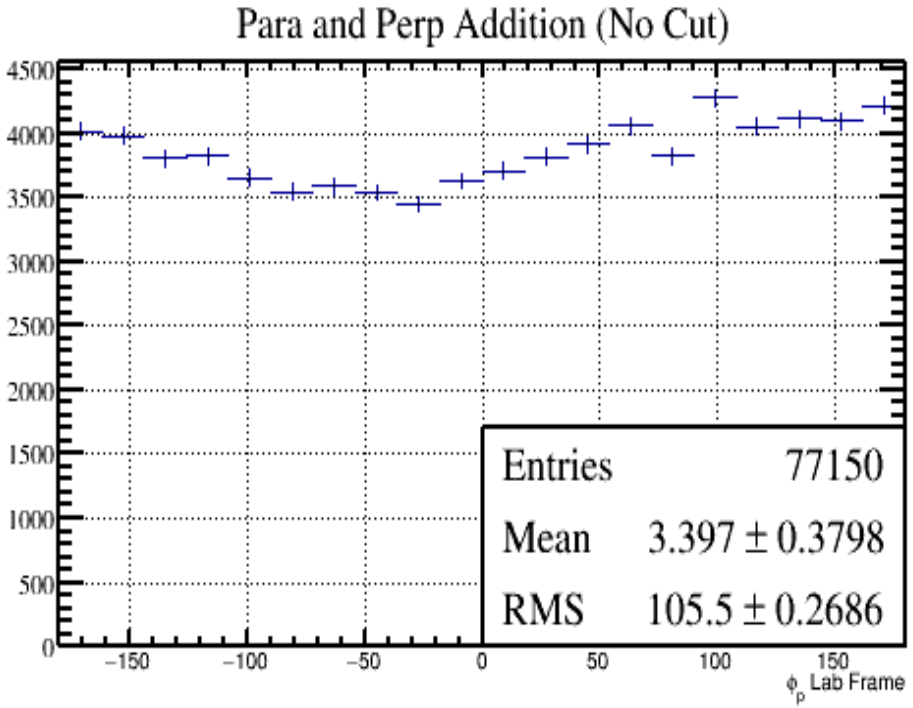


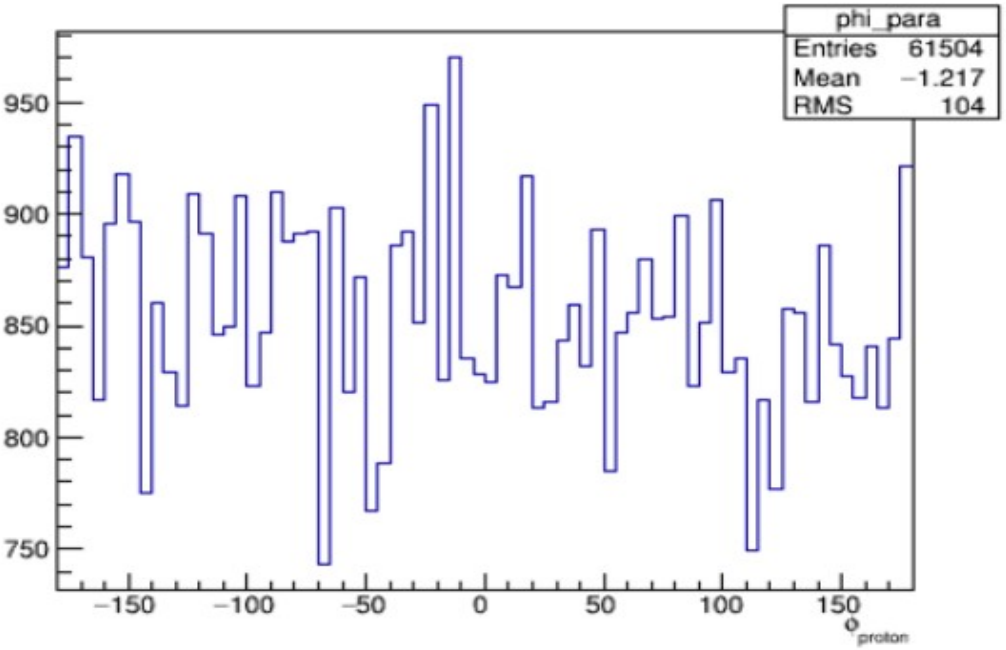
try: $\frac{Y_\perp - Y_\parallel}{Y_\perp + Y_\parallel} = P\Sigma cos(2\phi)$



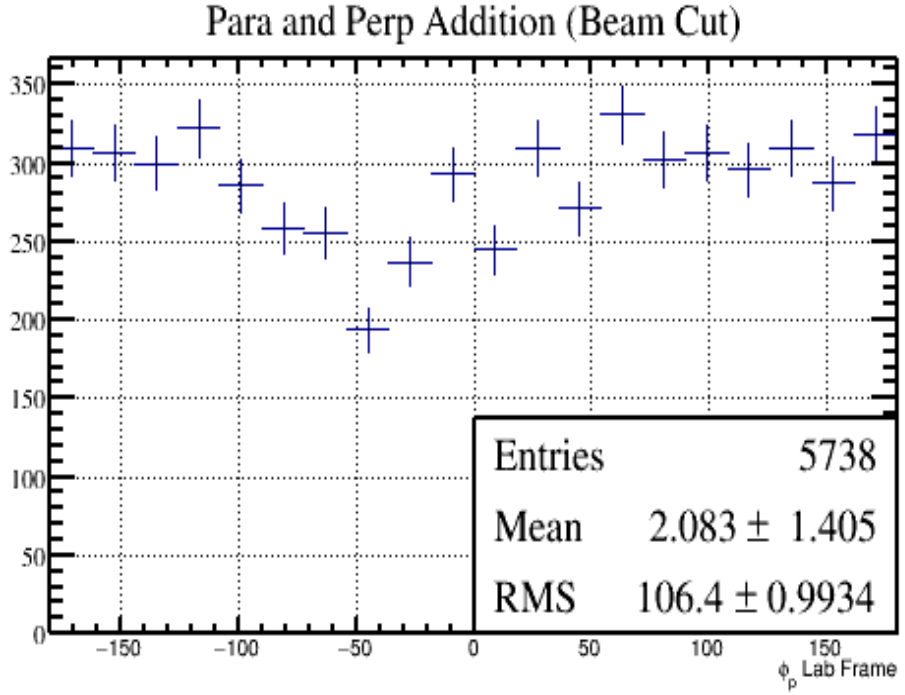


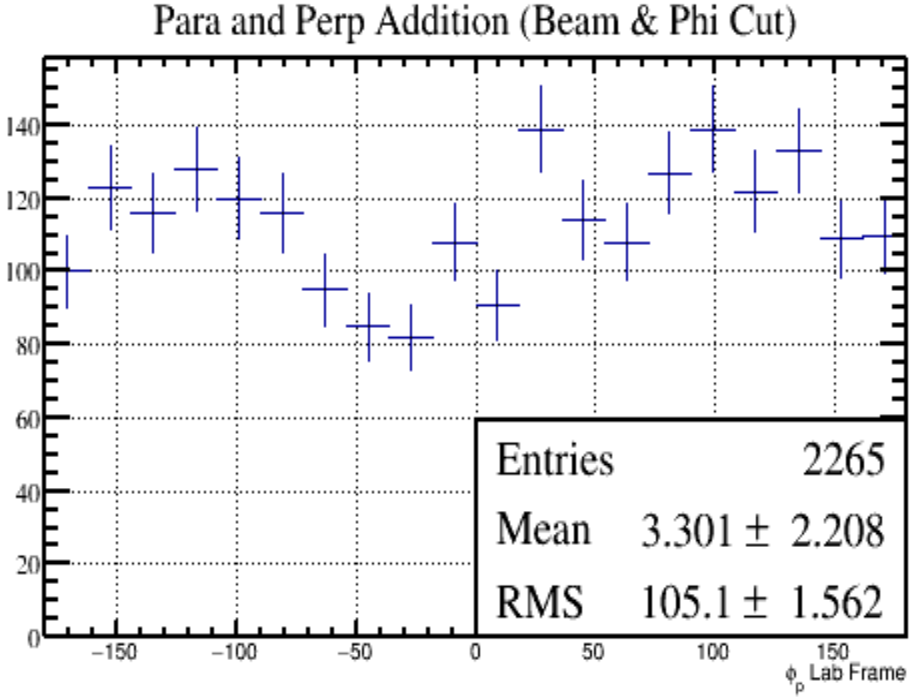
Add Beam Results





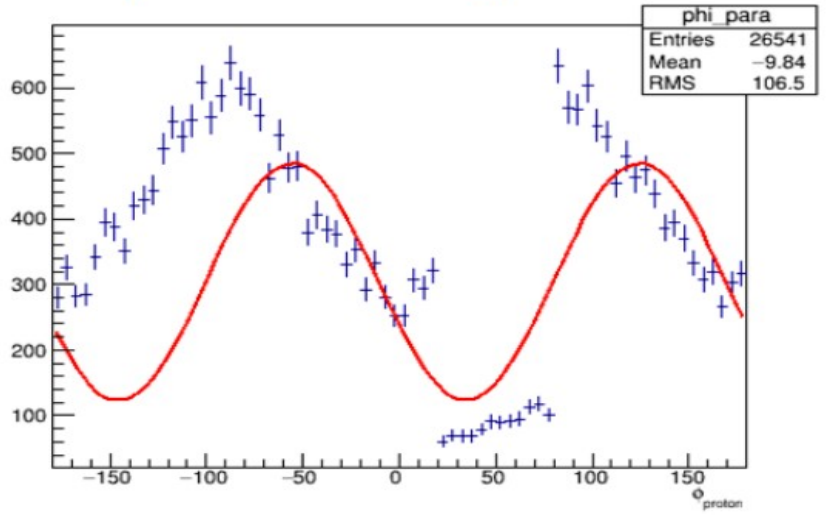
$$Y_{\perp} + Y_{\parallel}$$



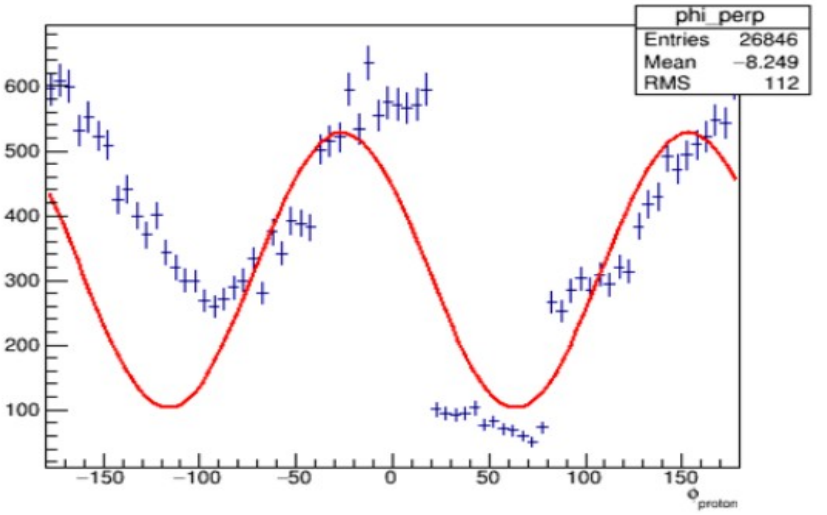


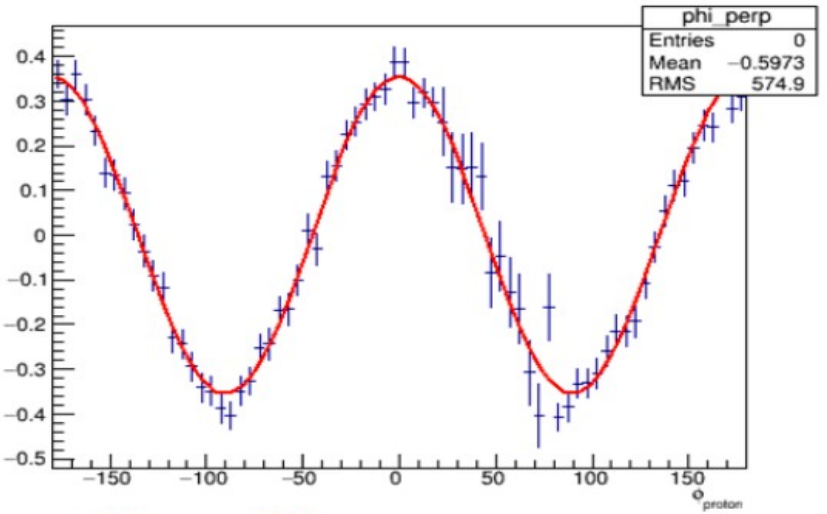
Beam Asymmetry Study with Inefficiency

$d\sigma_{\parallel} \sim 1 - P_{\parallel}\Sigma cos2\phi$

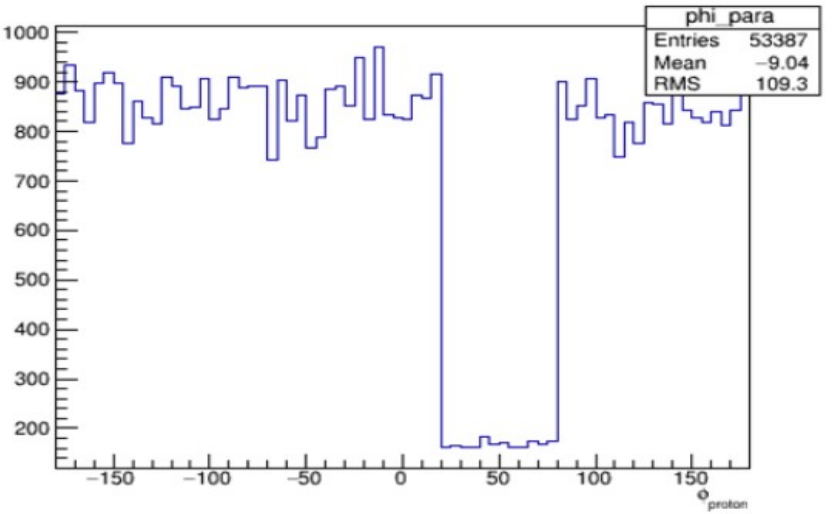


$d\sigma_{\perp} \sim 1 + P_{\perp}\Sigma cos2\phi$



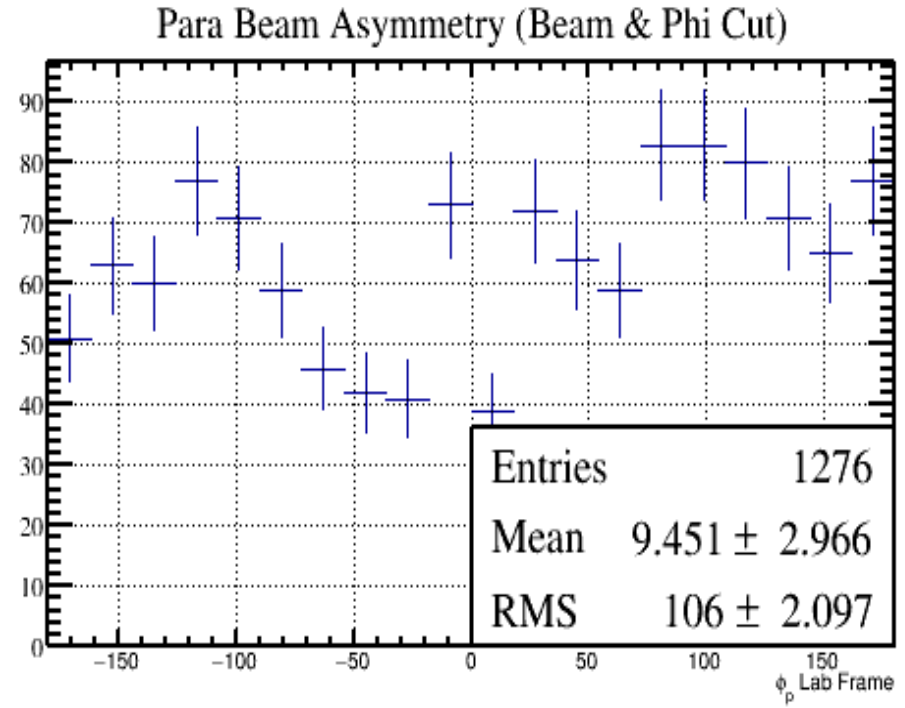


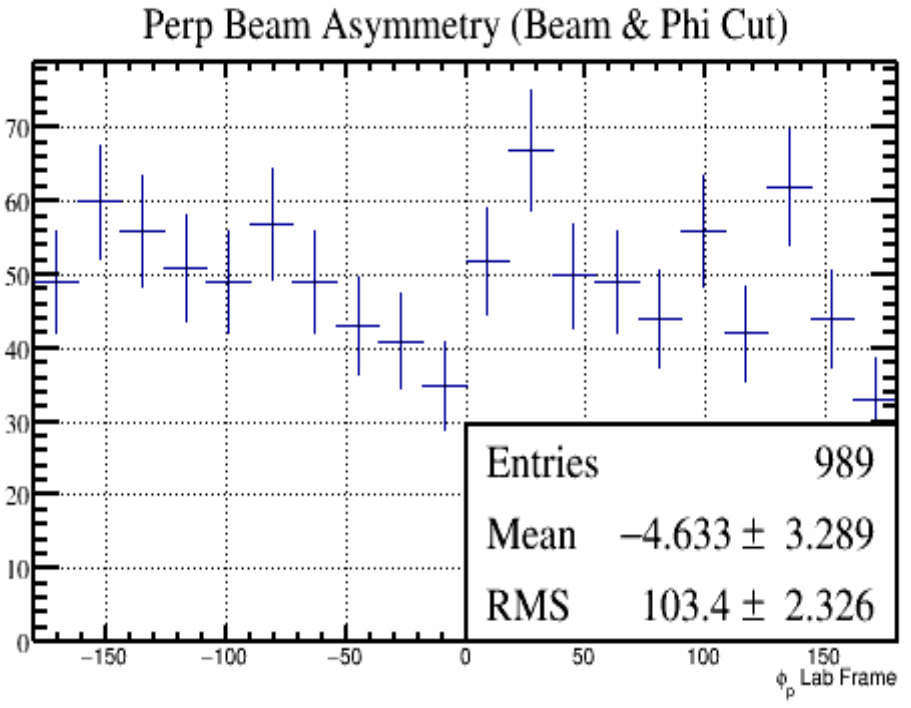
$$\frac{Y_{\perp} - Y_{\parallel}}{Y_{\perp} + Y_{\parallel}} = P\Sigma cos(2\phi)$$

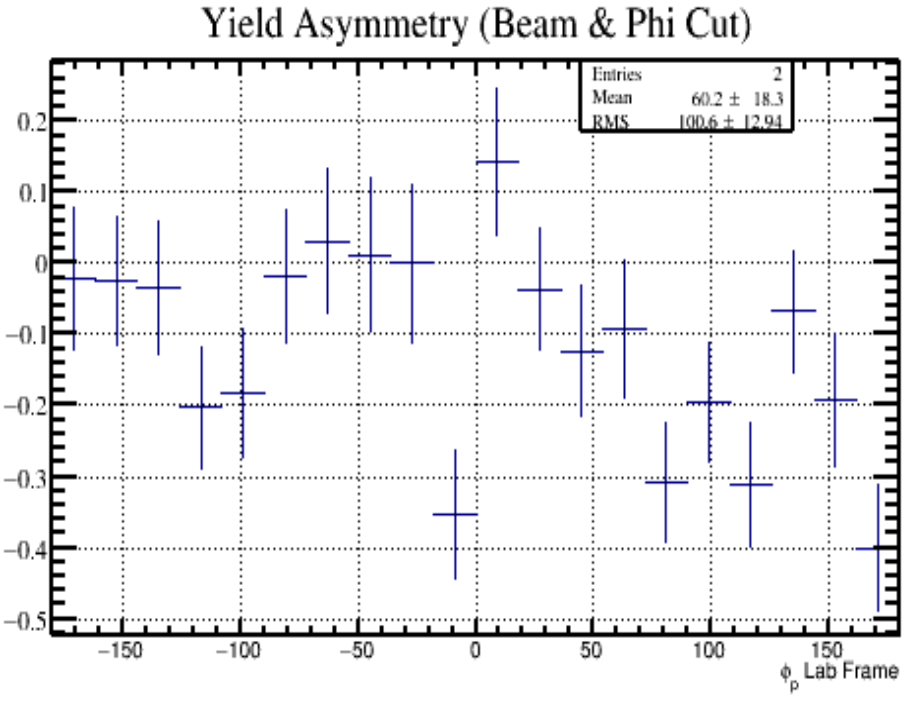


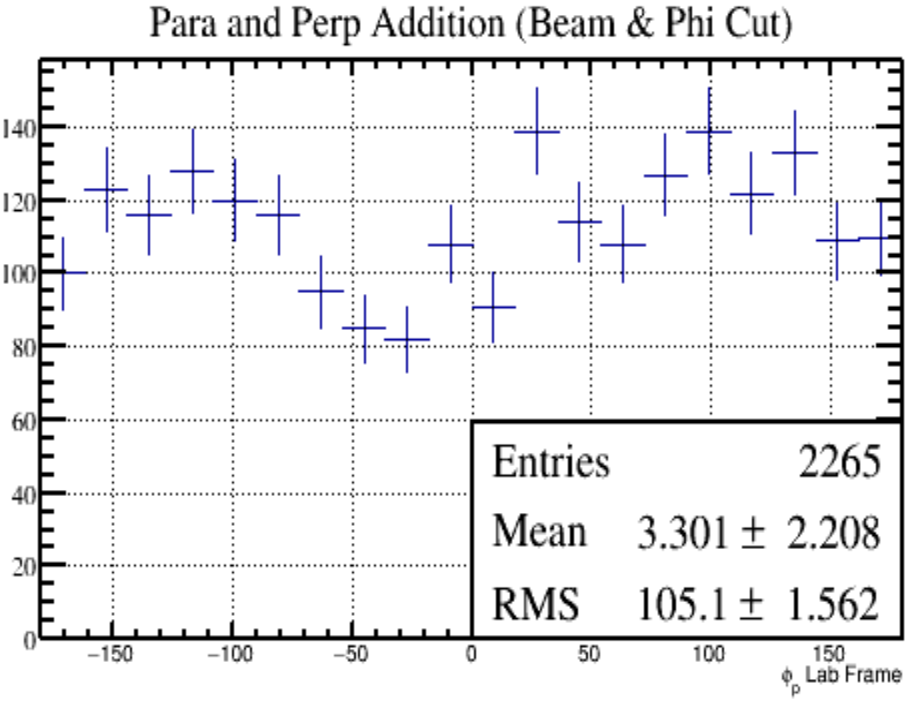
$Y_{\perp} + Y_{\parallel}$

Issue at ~ -50?


Para Beam Asymmetry (Beam & Phi Cut)
Entries 1276
Mean 9.451 ± 2.966
RMS 106 ± 2.097
ϕ_p Lab Frame


Perp Beam Asymmetry (Beam & Phi Cut)
Entries 989
Mean −4.633 ± 3.289
RMS 103.4 ± 2.326
ϕ_p Lab Frame


Yield Asymmetry (Beam & Phi Cut)
Entries 2
Mean 60.2 ± 18.3
RMS 100.6 ± 12.94
ϕ_p Lab Frame

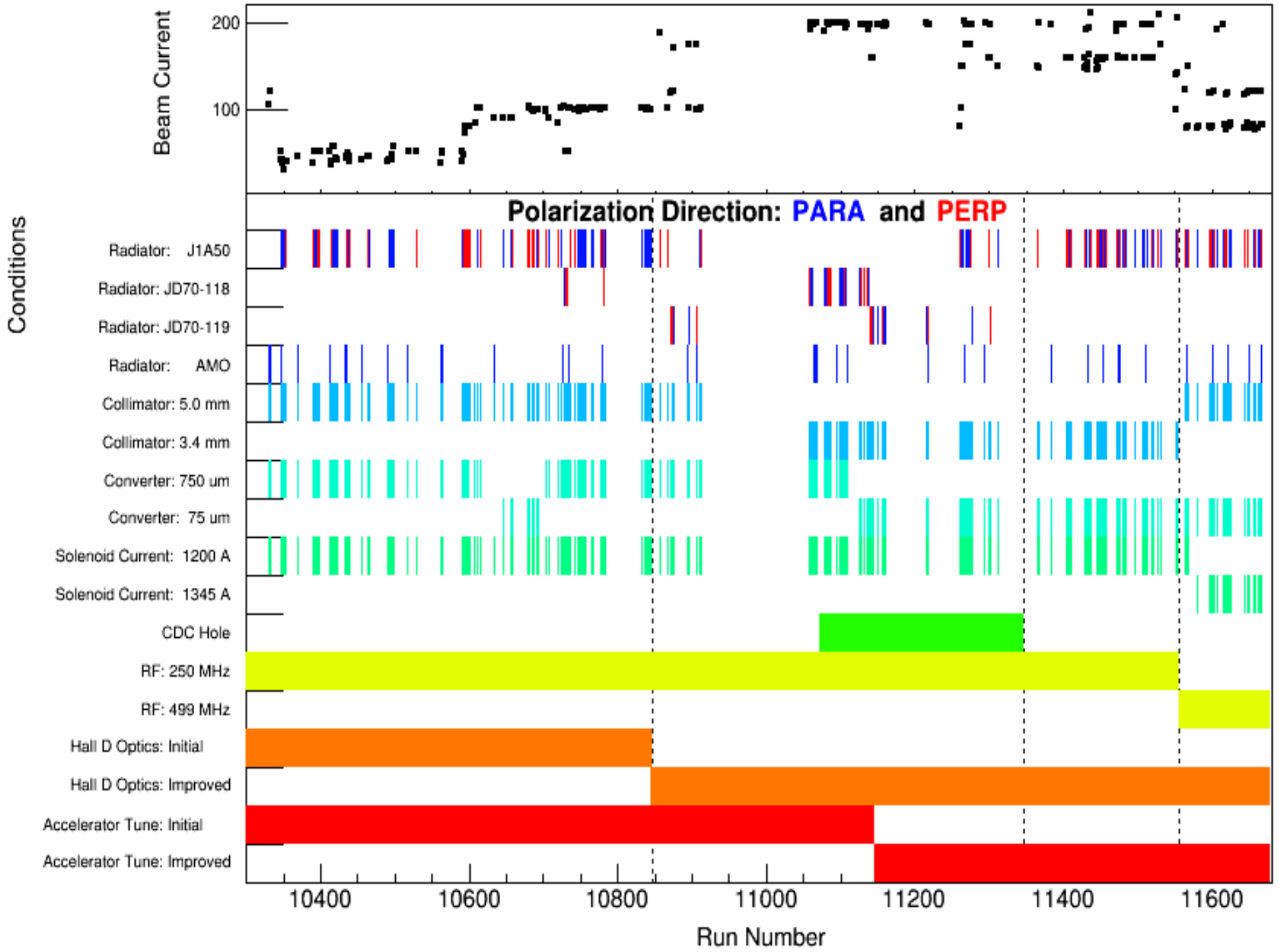

Para and Perp Addition (Beam & Phi Cut)
Entries 2265
Mean 3.301 ± 2.208
RMS 105.1 ± 1.562
ϕ_p Lab Frame

Conclusions

- Clearly these results are no good as of right now.
- Can't be due to the CDC hole:
  - My Runs [11484-11667]
- Could it be simple calibration issues in ver05? (The beam spectra that I observe still bothers me)
- Perhaps the proton phi distributions are an effect caused by baryon decay or a missed pi0?
- Plan:

  Now that we have run over the entire data set of the “good runs”, I will collect those statistics now and see what I find.

Spring 2016 Conditions Summary from RCDB (only @is_production and @status_approved runs):



One Good thing: K+ Distribution in HE